NATIONAL INSTITUTE OF SCIENCE & TECHNOLOGY (Autonomous)
(Approved by AICTE, New Delhi, Affiliated to BPUT: Rourkela)
INSTITUTE PARK, PALUR HILLS, BERHAMPUR, ODISHA -761 008

5th Semester B.Tech.

(Electrical Engineering)

Detailed Syllabus

Fifth Semester (Electrical Engineering)

Theory

Sl. No.	Category	Subject Code	Subject Name	L-T-P	Credit
1	PCC	19EE5PC01T	**PCC-6**: Power Electronics	3-0-0	3
2	PCC	19EE5PC02T	**PCC-7:** Control System Engineering	3-0-0	3
3	PCC	19EE5PC03T	**PCC-8:** Digital Signal Processing	3-0-0	3
4	PEC	**Professional Electives-2**		3-0-0	3
		19EE5PE01T	Power Station Engineering and Economy		
		19EE5PE02T	Sensors and Transducers		
		19EE5PE03T	Renewable Power Generation Systems		
		19EE5PE04T	Microprocessor and Microcontroller		
5	OEC	**Open Elective-1(for Other Branch Students)**		3-0-0	3
		19EE5OE01T	Renewable Energy Systems		
		19EE5OE02T	Sensors and Instrumentation		
		Open Elective-1(for EE Branch Students)			
		19IT5OE01T	Java Programming		
		19CS5OE01T	Introduction to Python Programming		
		19EC5OE01T	VLSI Design		
		19EC5OE02T	Microprocessor and Interfacing		
		19ME5OE01T	Engineering Management		
		19ME5OE03T	Micro Electro-Mechanical Systems		
		19CE5OE01T	Building Services and Maintenance		
		19CE5OE02T	Green Technology		
6	OEC	**Open Elective-2 (for Other Branch Students)**		3-0-0	3
		19EE5OE03T	Smart Grids		
		19EE5OE04T	Introduction to Electrical Properties of Materials		
		Open Elective-2 (for EE Branch Students)			
		19IT5OE02T	Computer Network		
		19CS5OE02T	Database Management System		
		19EC5OE03T	Embedded System Design		

		19EC5OE04T	Radar System Engineering		
		19ME5OE04T	Nanoscience and Technology		
		19CE5OE03T	Geo-Environmental Engineering		
		19CE5OE04T	Fluid Mechanics		
7	MC	**Mandatory Courses**		3-0-0	0
		19CM5MC01T	Constitution of India		
		19CM5MC02T	Essence of Indian Tradition Knowledge		
Total Credit (Theory)					**18**
Practical					
1	PCC	19EE5PC01L	Power Electronics Lab	0-0-2	1
2	PCC	19EE5PC02L	Control System Engineering Lab	0-0-2	1
3	PCC	19EE5PC03L	Digital Signal Processing Lab	0-0-2	1
4	PSI	19CM5PS01L	Summer Internship/ Training	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**22**

Subject Code : 19EE5PC01T	Subject Name: Power Electronics	L-T-P 3- 0- 0	Credit 3

COURSE OBJECTIVES:

1. To study the characteristics of power semi-conductor devices and commutation circuits.
2. To study and design the single phase half wave and full wave controlled converter.
3. To study the three phase converters with R, RL and RLE loads.
4. To study the operational characteristics of AC voltage controllers and power electronics applications.
5. To study the operation of Choppers and Inverters.

SYLLABUS

Module-1 **(10 Hours)**

Power Semiconductor Devices

Switching and V-I characteristic of devices: power diode, Thyristor family: SCR, TRIAC, GTO, Transistor Family: BJT, IGBT and MOSFET, Series and parallel grouping of SCR.

Triggering Methods

SCR: (Cosine Firing Scheme), BJT gate drive, IGBT gate drive, TRIAC firing circuit, Isolation of gate and base drive, Commutation Schemes: Current and Voltage Commutation, Line Commutation.

Protection of Devices

SCR: Over voltage, Over Current, dv/dt, di/dt, Gate Protection. Transistor: protection of power BJT, IGBT and power MOSFET, dv/dt & di/dt limitation.

Module-2 **(6 Hours)**

AC to DC converter

Un-controlled Diode rectifier: Single phase half wave and full wave rectifiers with R-L and R-L-E load, 3 phase bridge rectifier with R-L and R-L-E load. Phase Controlled Converter: Principle of phase controlled converter operation, single phase full converter with R-L and R-L-E load, 3 phase full converter with R-L and R-L-E load ,single phase semi converter with R-L and R-L-E load, 3 phase semi-converter with R-L and R-L-E load and effect of source inductance.

Module-3 **(6 Hours)**

AC –AC converter

AC voltage controller: Single phase bi-directional controllers with R and R-L load, Power Electronics converters for renewable energy systems.

Applications:
UPS, SMPS, Battery Chargers, SVC.

Module-4 **(6 Hours)**

DC to AC converter

Inverters: Single phase Bridge Inverters, 3-Phase Inverters-180° mode conduction, 120°mode conduction. Voltage control of 3-Phase Inverters by Sinusoidal PWM, Current Source Inverter.

Module-5: **(6 Hours)**

DC to DC converter

Classification: First quadrant, second quadrant, first and second quadrant, third and fourth quadrant, fourth quadrant converter. Switching mode regulators: Buck regulators, Boost regulators, Buck-Boost regulators, Isolated Types: Fly Back Converters, Forward converters, Push Pull Converters, Bridge Converter and Bi-directional Converters.

COURSE OUTCOMES:

After completion of this course the students would gain enough knowledge.

1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. Ability to analyze various single phase and three phase power converter circuits and understand their applications.
3. Foster ability to identify basic requirements for power electronics based design application.
4. To develop skills to build, and troubleshoot power electronics circuits.
5. Foster ability to understand the use of power converters in commercial and industrial applications.

TEXT BOOKS:

1. Power Electronics: Circuits, Devices and Applications by M H Rashid, 4th Edition, Pearson Education, 2017.

2. Power Electronics: By P. C. Sen, Tata McGraw Hill Education, 2nd Edition, 2017.

REFERENCE BOOKS:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, 3rd Edition, John Wiley and Sons Publications, 2007.
2. Power Electronics by P.S. Bimbhra, Khanna Publishers, Sixth Edition, 2018.
3. Elements of Power Electronics: Philip T. Krein, Oxford University Press, 2nd Edition, 2017.
4. Power Electronics by M.D. Singh and K.B. Khanchandani, Tata McGraw Hill Education.

DIGITAL LEARNING RESOURCES:

Couse Name	Power Electronics
Course Link	https://nptel.ac.in/courses/108/101/108101038/
Course Instructor	Prof. B.G Fernandes, Electrical Engineering, IIT Bombay

Subject Code: 19EE5PC02T	Subject Name: Control System Engineering	L-T-P 3- 0- 0	Credit 3

COURSE OBJECTIVES:

1. The students should be able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.
2. The students should learn how to represent system by transfer function and block diagram reduction method and Mason's gain formula.
3. The students should able to learn time response analysis and demonstrate their knowledge to frequency response.
4. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot and Nyquist plot.

SYLLABUS

Module-1: **(10Hours)**

Mathematical Modeling of Physical Systems and Transfer Function Representation

Introduction: Basic Concepts of Control Systems, Open loop and closed loop systems.

Feedback Characteristics of Control Systems: Feedback and Non-feedback System, effect of Feedback on Overall gain, stability, sensitivity, and external disturbance or noise. Types of feedback control systems, linearizing effect of feedback,

Mathematical Modeling of Physical Systemsand Transfer function representation: Impulse response and transfer functions of linear systems, Applications of Laplace Transform to Control System, Determination of Transfer functions by block diagram algebra, and Signal Flow Graphs. Concepts of State and state variable model, modeling of physical systems. Linearization of Nonlinear systems, systems with transport lag.

Control System and Components: Servo Mechanism/Tracking System, Modeling of DC Servomotor, AC Servomotor, Synchros.

Module-2: **(10Hours)**

Time Domain Analysis and Stability of Linear control systems

Time response Analysis: Typical test Signals for Time response of control systems Steady State Errors and Static Error Constants. Step and impulse responses of first order, second order and higher order

systems, time domain specifications, Transient response of a prototype second order systems, time domain analysis of a position- control systems, effects of adding poles and zeros to transfer functions.

Stability of Linear control systems: Concept of stability, BIBO stability, zero-input and asymptotic stability of continuous – data systems, methods of determining stability, Rout- Hurwitz Criterion.

Root locus Technique: Basic properties of the root loci, properties and construction of Root Loci. Root Contour.

Module-3: (10Hours)

Frequency Domain Analysis and Stability in Frequency Domain

Frequency Response Analysis: Frequency response of closed – Loop systems, frequency domain specifications. Correlation between time response and frequency Response Characteristics.

Stability in Frequency Domain: Mathematical Preliminaries, Stability analysis using Bode plot, polar plot, Nyquist Stability Criterion, Relative stability.

Closed loop frequency response: Constant – M Loci in the G (jω) -plane, Constant – Phase Loci in the G (jω) – plane, Constant – M Loci in the Magnitude – Phase Plane: Nichols Chart.

Module-4: (6 Hours)

Design of Control Systems

Design of control systems with PD, PI, PID, Phase – Lead, Phase – Lag, and Lead- Lag Controllers. Forward and Feed Forward Controllers.

Module-V: State Space Analysis of Continuous Time Systems (6 Hours)

State Variable Analysis: State transition Matrix, solution of state equations, controllability and observability, Conversion of state space model to transfer function model, Conversion of transfer function model to state space model.

COURSE OUTCOMES:

After completion of this course the students will be able to:

1. Identify open and closed loop control system, Formulate mathematical model for physical systems and Simplify representation of complex systems using reduction techniques.
2. Use standard test signals to identify performance characteristics of first and second-order systems.
3. Apply root locus technique for stability analysis.

4. Analyze performance characteristics of system using Frequency response methods

TEXT BOOKS:

1. "Modern Control Engineering" by K. Ogata, 5th edition, WordPress publications (2016).
2. "Control Systems Engg." by I.J. Nagrath and M.Gopal, 6th Edition, New Age International Publishers (2017).

REFERENCE BOOKS:

1. "Automatic Control Systems" by Benjamin C. Kuo, 7th Edition, Prentice-Hall India publication (1995)
2. "Modern Control Systems" by Richard Dorf, and Robert Bishop, 13thEdition, PearsonPublications (2016).
3. "Design of Feedback control systems" by Stephani, Shahain, Savant and Hostetter, 4th edition, Oxford publications (2006).

DIGITAL LEARNING RESOURCES:

Course Name	Control Engineering
Course Link	https://nptel.ac.in/courses/108/102/108102043/
Course Instructor	Prof. Madan Gopal, Department of Electrical Engineering, IIT Delhi

Subject Code: 19EE5PC03T	Subject Name: Digital Signal Processing	L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVES:

The objective of this course is to introduce students to

1. Understand thoroughly the frequency domain analysis of discrete time signals.
2. Do mathematical modeling of digital filters.
3. Structural Implementation of digital filters.
4. Find the concepts of multi-rate signal processing and use of adaptive filter in real-time applications of DSP.

SYLLABUS

Module-1 **(8 Hours)**

Z-Transform & its Applications:

Overview of Discrete time signals and systems. Z-Transform and Its Application to the Analysis of LTI Systems: Direct Z-Transform, Properties of the Z- Transform, Inverse Z-Transform by Power Series Expansion, and Partial-Fraction Expansion, Analysis of Linear Time Invariant Systems in the Z-Domain.

Module-2 **(10 Hours)**

Discrete Fourier Transform:

Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, DFT as a Linear Transformation, Relationship of DFT to other Transforms, Properties of DFT. Use of DFT in Linear Filtering: Sectional Convolution. Introduction to the Fast Fourier Transform (FFT) algorithm, Radix 2 Decimation in Time (DIT), Radix 2 Decimation in Frequency (DIF).

Module-3 **(8 Hours)**

Digital Filter Design:

Design of FIR filters: Impulse Response of ideal LPF, HPF, BPF and BSF, Frequency response of linear phase FIR filters by Windowing methods and Frequency Sampling method.

Design of IIR filters: Butterworth, and Chebyshev, Conversion to digital IIR Filter using Impulse Invariance Technique and Bilinear Transformation. Frequency transformation in analog and digital domain.

Module-4 **(4Hours)**

Structure and Implementation of FIR and IIR Filter:

Structure of IIR Systems: Direct form – I realization Direct form – II realization. Structure of FIR Systems: Direct- Form Structure, Cascade-Form Structure, and Frequency Sampling Structure.

Module-5 **(6Hours)**

Multi-rate DSP & Adaptive Filter:

Multi-rate DSP: Introduction to Multi-rate DSP, Decimation, Interpolation, Sampling rate conversion by rational factor, Implementation of sampling rate conversion.

Adaptive filters: Adaptive Wiener filter and LMS algorithm, Application of Adaptive Filters: System Identification or System Modeling, Adaptive Channel Equalization, Adaptive Line Enhancer, Adaptive Noise Cancelation.

COURSE OUTCOMES:

On Completion of this course, the students should be able to:

1. Apply the discrete time transform techniques to analyze the discrete time signals and systems.
2. Implement various digital signal processing algorithms for realization of efficient systems by reducing computational complexity.
3. Design, analyze and compare digital filters based on their complexity and stability.
4. Apply multi-rate signal processing and adaptive filter theory in practical applications used for signal processing.

TEXT BOOKS:

1. Digital Signal Processing by J. G. Proakis and D. G. Manolakis, 4th Edition, 2007, Pearson Publication.
2. Digital Signal Processing by Tarun K. Rawat, 2015, Oxford University Press.

REFERENCE BOOKS:

1. Digital Signal Processing, a Computer-Based Approach, Sanjit K. Mitra, 1987, TMH
2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, 2001, TMH.
3. Statistical Digital Signal Processing and Modelling, Manson H. Hayes, 1996, Wiley.
4. Advanced Digital Signal Processing, Shalia D. Apte, 2013, Willey Publication

DIGITAL LEARNING RESOURCES:

Course Name	Digital Signal Processing
Course Link	https://nptel.ac.in/courses/117/102/117102060/
Course Instructor	Prof. S. C. Dutta Roy, IIT Delhi

Course Name	Digital Signal Processing
Course Link	https://nptel.ac.in/courses/117/105/117105144/
Course Instructor	Prof. Govind Sharma, IIT Kanpur

Subject Code: 19EE5PE01T	Subject Name: Power Station Engineering & Economy	L-T-P 3- 0- 0	Credit 3

COURSE OBJECTIVE:

1. The students will be able to learn the general concepts of energy scenario in India, and what are the different factors affecting to power generation.
2. After some introductory lectures, the students will be investigating the problems related to factors and to know about power plant economics.
3. The students should learn topics related to nuclear power station and brief study of various types of reactors.
4. The students should learn topics related to hydro power stations and various types of turbines.
5. Students can be able to learn the thermal power station and different types of boilers. The students will have an idea about chimney, condenser, evaporators and electrostatic precipitator.

SYLLABUS

Module-1 **(10 Hours)**

Introduction: Introduction to different sources of energy and general discussion on their application to generation, Indian energy scenario, Load duration curves, load factor, Capacity factor, Reserve factor, Demand factor, demand factor, problems related to all factors,

ECONOMICS OF POWER GENERATION: Construction costs, Fixed cost and Depreciation, Fuel cost, Economic scheduling principle, Annual Operating Costs, Effect of Load Factor on cost per kWh,

NUCLEAR POWER STATION: Introduction to fission & fusion, reactor construction, controlled chain reaction, operational control of reactors, Brief study of various types of reactors, Boiling water, pressurized water, heavy water, breeder, Location and layout of nuclear power plant.

Module-2 **(12 Hours)**

Nuclear power station: Introduction to fission & fusion, Principle of Nuclear Energy, Reactor Construction, Controlled Chain Reaction, Brief study of various Types of Power Reactor, Operational Control of Reactors, Location and layout of nuclear power plant, Economics of Nuclear Power Station.

Module-3 **(8 Hours)**

Hydro Electric power station: Selection of site for hydro-electric power plant. Hydrology: Hydrological cycle, precipitation, run-off and its measurement, hydrograph, flow duration and mass curves, Estimation of amount stored by a dam across the river, Storage and Pondage, Elementary idea about Earthen and Concrete Dam.

Module-4 **(8 Hours)**

Types of Turbines: Operational principle of Kaplan and Francis Turbine and Pelton wheel, Speed and Pressure Regulation, Work done and Efficiency. Arrangement and location of Hydroelectric Station: Catchment area, Reservoir, Dam, Head Gate, Spillways, Pen stock, Surge Tanks, Scroll case, Draft tubes and Tail Race, Power House, Classification of Hydroelectric Power Plants.

Module-5 **(10 Hours)**

Thermal power station: Selection of site for thermal power plant. Main Parts and Working of a Steam Station: Overall Block Diagram indicating the air circuit, coal and ash circuit, water and steam circuit, various types of steam turbines, ash and coal handling system, High Pressure and High capacity water tube boilers, Economizer, Superheaters, De-Superheater, Re-heater, Air Pre-heater Draft System: Natural, Induced Forced and Balance Draft, PA fan, FD fan, ID fan, Chimney. Condensers, Feed water heaters, Evaporators, Make-up water, bleeding of steam, cooling water system. Electrostatic Precipitator: Basic working Principle and constructional details Governors, Plant auxiliaries.

COURSE OUTCOMES:

After completion of this course the students will be able to:

1. Gains about the Indian energy scenario and learn about the various factors affecting generation. The students have the idea of power plant economics.
2. Learn about the nuclear power station. The students will design the layout of nuclear power plant.
3. Design the layout of hydro power plant and learn about various types of turbines.
4. Design overall diagram of thermal power plant and have the idea about the electrostatic precipitator.

TEXT BOOKS:

1. P. K. Nag, “Power Plant Engineering”, 3rd Edition, Tata McGraw Hill Publication.
2. M. V. Deshpande, “Elements of Electrical Power Station Design”, PHI.

3. Bernhardt G. A. Skrotzki, William A. Vopat, “Power Station Engineering and Economy”, 2nd Edition, Tata McGraw Hill Publication.

REFERENCE BOOKS:

1. Arora &Domkundwar, “A Course in Power Plant Engineering”, Dhanpat Rai and sons.
2. R. K. Rajput, “A Text Book of Power Plant Engineering”, 3rd Edition, Laxmi Publishing.

DIGITAL LEARNING RESOURCES:

Course Name	Energy Resources and Technology
Course Link	NPTEL visit http://nptel.iitm.ac.in.
Course Instructor	Prof.S.Banerjee,Department of Electrical Engineering, IIT Kharagpur.

Subject Code: 19EE5PE02T	Subject Name: Sensors and Transducers	L-T-P 3- 0- 0	Credit :3

COURSE OBJECTIVES:

1. The students will understand the concepts of measurement technology.
2. They learn the various sensors used to measure various physical parameters.
3. They will learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

SYLLABUS

Module -1 **(9 Hours)**

Elements of a general measurement system: Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

(Bentley: Chapters 1-4)

Module-2 **(8 Hours)**

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors; Electromagnetic sensing elements: velocity sensors.

(Bentley: Sections 8.1 to 8.6)

Module-3 **(8 Hours)**

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.

(Ghosh: Section 10.3 to 10.4)

Module-4 **(8 Hours)**

Signal Conditioning Elements: Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity. Amplifiers: Operational amplifiers-ideal and

non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation

(Bentley: Sections 9.1 to 9.3; Ghosh: Sections 15.1 and 15.2)

Module-5 (Additional Module) **(8 Hours)**

Digital and Semiconductor Sensors: Position Encoders, Resonant Sensors, SAW Sensors, Sensors Based On Semiconductor Junctions, Sensors Based On MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic-Based Sensors. Sensors for Robotics: Proximity Sensors: Typical Sensor Characteristics, Technologies for Proximity Sensing, Electro-Optical Sensors, Capacitive Sensors, Magnetic Sensors.

COURSE OUTCOMES:

At the end of the course, a student will be able to:

1. Use concepts in common methods for converting a physical parameter into an electrical quantity.
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light.
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors

TEXT BOOKS:

1. Principles of Measurement Systems- J.P. Bentley (3/e), Pearson Education, New Delhi, 2007.
2. Introduction to Measurement and Instrumentation- A.K. Ghosh (3/e), PHI Learning, New Delhi, 2009.

REFERENCE BOOKS:

1. Measurement Systems Application and Design- E.O. Doeblin (4/e), McGraw-Hill, International, NY.
2. Electronic Measurements and Instrumentation, Instrumentation for Engineering Measurements- J.W. Dally, W.F. Riley and K.G. McConnel (2/e), John Wiley, NY, 2003.
3. Industrial Instrumentation- T.R. Padmanabhan, Springer, London, 2000.
4. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010

DIGITAL LEARNING RESOURCES:

Course Name	Sensor and Transducer
Course Link	https://nptel.ac.in/courses/108/108/108108147/ https://nptel.ac.in/courses/108/105/108105064/
Course Instructor	Dr. Hardik Jeetendra Pandya, Department of Electronic Systems Engineering, IISc Bangalore Prof. Alok Barua, Department of Electrical Engineering, IIT Kharagpur.

Subject Code: 19EE5PE03T	Subject Name: Renewable Power Generation Systems	L-T-P 3-0-0	Credit : 3

COURSE OBJECTIVES:

The program is expected to enable the students to

1. Design and develop innovative products and services in the field of Renewable Energy.
2. Keeps abreast with the latest technology and toolset.
3. Communicate effectively to propagate ideas and promote teamwork
4. Attain intellectual leadership skills to cater to the changing needs of power industry, academia, society and environment

SYLLABUS

Module-1 **(7 Hours)**

Introduction: Conventional energy Sources and its Impacts, Non-conventional energy– seasonal variations and availability, Renewable energy – sources and features, Distributed energy systems and dispersed generation (DG). Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system-Solar collectors, Types and performance characteristics, Applications-Solar water heating systems(active & passive) , Solar space heating & cooling systems , Solar desalination systems, Solar cooker.

Module-2 **(7 Hours)**

Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array, Losses in Solar Cell, Effects of Shadowing-Partial and Complete Shadowing, Series and parallel connections, Cell mismatching, Maximum power point tracking, Applications-Battery charging, Pumping, Lighting, Peltier cooling, Modelling of PV cell.

Module-3 **(10 Hours)**

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self-excited induction generator operation, constant

voltage and constant frequency generation with power electronic control single and double output systems, reactive power compensation, Characteristics of wind power plant, Concept of DFIG.

Module-4 **(9 Hours)**

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves, Bio diesel, Combustion engine, Application.

Module-5 **(6 Hours)**

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

COURSE OUTCOME:

1. Appraise the need and possibility of extracting solar energy and converting into electrical energy using PV cell.
2. Design and analyze stand-alone and grid connected PV system.
3. Describe the dynamics of wind turbine and electrical generator.
4. Select and design suitable configuration of the wind energy conversion system based on application.
5. Suggest, design and analyze hybrid energy systems.

TEXT BOOKS:

1. Godfrey Boyle, “Renewable Energy- Power for a Sustainable Future”,Oxford University Press.
2. B.H.Khan, “Non-Conventional Energy Resources”,Tata McGrawHill, 2009.
3. S. N. Bhadra, D. Kastha, S. Banerjee, “Wind Electrical Systems”,Oxford University Press, 2005.
4. S. A. Abbasi, N. Abbasi, “Renewable Energy Sources and Their Environmental Impact”, Prentice Hall of India, New Delhi, 2006.

REFERENCE BOOKS:

1. S. Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press, 1st Edition, 2013.

2. N. D. Hatziargyriou, “Microgrids Architecture and control”, IEEE Press Series, John Wiley & Sons Inc, 1st Edition, 2013.

DIGITAL LEARNING RESOURCES:

Course Name	Solar, Wind and Biomass Energy Systems
Course Link	https://nptel.ac.in/courses/103/103/103103206/
Course Instructor	Prof. R. Anandalakshmi Prof. Vaibhav Vasant Goud, Department of Chemical Engineering, IIT Guwahati
Course Name	Solar & Wind Energy
Course Link	https://nptel.ac.in/courses/103/107/103107157/
Course Instructor	Prof. P. Mondal, Department of Chemical Engineering, IIT Roorkee
Course Name	Energy Resources
Course Link	https://www.youtube.com/watch?v=cZSYukWvpsE
Course Instructor	Prof. Rangan Benarjee, Department of Energy Science & Technology, IIT Bombay
Course Name	Design of Photovoltaic system
Course Link	https://www.youtube.com/watch?v=hr2sId412zU&list=PLuv3GM6-gsE2KyXoBTQ6lbrwn22Z3SiVm&index=2
Course Instructor	Prof. L. Umanand, Department of Electronic System Engineering, IISC Bangalore

Subject Code: 19EE5PE04T	Subject Name: Microprocessor and Microcontroller	L-T-P 3-0-0	Credit : 3

COURSE OBJECTIVES:

1. Understand the main components and working principle of the Intel 8086 microprocessor.
2. Understand the Memory organization, interfacing and the interrupt concept of 16-bit microprocessor
3. Program and debug in assembly language program
4. Understand the properties and interfacing of the I/O devices using programmable interfacing devices.
5. Understand the main components and working principle of the Intel 8051 microcontroller.

SYLLABUS

Module-1 **(10 Hours)**

8086 Microprocessor

Introduction: Overview of Microcomputer organization Intel 8086, Microprocessor: Introduction, 8086 Programmer's model: Register organization, Hardware Architecture: Bus interface unit (BIU), Execution unit (EU), Pipelined operation, physical address generation and Memory segmentation. 8086 Pin description: Common, Minimum and maximum mode Pin and Signals, Bus cycle and System configuration.

Module-2 **(6 Hours)**

8086 Memory Interfacing and Interrupt technique 8086 Memory Interfacing: External Memory addressing, EPROM and RAM interface with 8086. 8086 Interrupt: Interrupt Processing, sources of interrupt in 8086, Interrupt Instructions, Interrupt types, IVT, Hardware Interrupts and Interrupt priorities.

Module-3 **(6 Hours)**

8086 Instruction set and programming

8086 Addressing modes, Instruction sets, Assembler directives and programming

Module-4 **(10 Hours)**

Peripheral interfacing

Introduction to basic I/O interface, I/O interfacing techniques in 8086 Interfacing devices:8255 PPI, 8251 USART,ADC-0808/0809,DAC-0800interfacing using PPI.

Module-5 **(8 Hours)**

8051 Microcontroller

Introduction to 8051 Micro-Controllers, Architecture, pin and signals,list of Special Function registers, Description of basic registers (A, B, SP, PC, DPTR, PSW), Memory Organization;External Memory Interfacing, I/O port programming; Interrupts operation and its programming; Programmer's model of 8051; Operand types, Operand addressing; Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions; Programming.

COURSE OUTCOMES:

On Completion of this Subject/ Course the students should be able to:

1. Gain knowledge on 8086 microprocessor architecture and its memory interfacing.
2. Identify the addressing modes and apply the knowledge in assembly language programming.
3. Illustrate the design aspect of programmable peripheral devices with the 8086 microprocessor.

TEXT BOOKS:

1. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals",Tata McGrawHill,2000.
2. Walter A Triebel and Avtar Singh,The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications4e, Pearson Education
3. The 8051 Microcontroller and Embedded Systems using assembly and C by M.A. Mazidi, J.G. Mazidi, Pearson.

REFERENCE BOOKS:

1. Barry B. Brey, The Intel Microprocessors, Architecture, Programming and Interfacing-, 8e, 2009, Pearson Education, ISBN 0-13-502645-8
2. Doughlas.V.Hall, " Microprocessor and Interfacing : Programming and Hardware", 2nd edition, McGraw Hill, 1991

3. Yu-cheng liu and Glenn a.Gibson,Microcomputer Systems: The 8086/8088 Family Architecture, Programming & Design-, 2nd Edition, Prentice Hall of India, 2007.

Subject Code: 19EE5OE01T	Subject Name: Renewable Energy Systems	L-T-P 3-0-0	Credits 3

COURSE OBJECTIVE:

The program is expected to enable the students to

1. Design and develop innovative products and services in the field of Renewable Energy.
2. Keeps abreast with the latest technology and toolset.
3. Communicate effectively to propagate ideas and promote teamwork
4. Attain intellectual leadership skills to cater to the changing needs of power industry, academia, society and environment

SYLLABUS

Module- 1 **(4 Hours)**

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Quality of Energy: Measure of Quality of energy, Identification of potential energy resources in terms of their quality. Dependency of Efficiency of energy conversion on Quality of energy. Cogeneration, Dispersed or Distributed generation.

Module- 2 **(8Hours)**

Energy from Sun: Sun- earth Geometric Relationship, Solar radiation geometry, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Sunpath diagram and evaluation of insolation quality at a location using Sunpath, Solar Thermal Energy Applications.

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Module-3 **(7Hours)**

Solar Photovoltaic Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Equivalent Circuit of a PV Cell, Impact of parameters of PV cell performance, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Maximum Power Point Tracking (MPPT), MPPT algorithms: P&O, Incremental Conductance, Efficiency of Solar Cells, Photovoltaic Panels, Shading & Mitigation techniques, Applications of Solar Cell Systems.

Module- 4 **(10Hours)**

Wind Energy Conversion System (WECs): Energy content in wind, extractible content of energy through WECs. Types of wind turbines with respect to axis of rotation (Horizontal & vertical axis wind turbine), working principle (lift and drag type) etc.

Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor &Blade), significant parameters determining efficiency of WECs, Pitch angle, No of blades, solidity, Tip Speed ratio.

Constant speed Constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator.

Module-5 **(10Hours)**

Integrated Energy Systems: System Aspects of Integration: voltage effects, thermal effects, fault level. Islanding. Stand Alone Systems: Network voltage and system efficiency, Case studies of standalone system. Hybrid Energy Systems and its economic evaluation. Technological aspects of power electronic systems connection to the grid. Hybrid and integrated energy systems, Total energy concept and waste heat utilization, Energy modeling to optimize different systems.

COURSE OUTCOMES:

1. Appraise the need and possibility of extracting solar energy and converting into electrical energy using PV cell.
2. Design and analyze stand-alone and grid connected PV system.
3. Describe the dynamics of wind turbine and electrical generator.
4. Select and design suitable configuration of the wind energy conversion system based on

application.

5. Suggest, design and analyze hybrid energy systems.

TEXT BOOKS:

1. Non-conventional Energy Sources by G.D. Rai (Author), Khanna Publishers.
2. Renewable Energy, by Boyle, Godfrey. Oxford University Press.
3. Renewable Energy Systems – Design and Analysis with Induction Generators, by M.GodoySimoes, Felix A.Farret, CRC press.
4. Micro-grid: A Conceptual Solution, Robert Lasseter, Paolo Piagi, PESC 2004, June 2004.

REFERENCE BOOKS:

1. Renewable Energy Resources by John Twidell and Tony Weir, Taylor Francis Group.
2. Renewable Energy Sources for fuels and Electricity by Laurie Barrtom, Island Press.

DIGITAL LEARNING RESOURCES:

Course Name	Solar, Wind and Biomass Energy Systems
Course Link	https://nptel.ac.in/courses/103/103/103103206/
Course Instructor	Prof. R. Anandalakshmi Prof. Vaibhav Vasant Goud, Department of Chemical Engineering, IIT Guwahati
Course Name	Solar & Wind Energy
Course Link	https://nptel.ac.in/courses/103/107/103107157/
Course Instructor	Prof. P. Mondal, Department of Chemical Engineering, IIT Roorkee
Course Name	Energy Resources
Course Link	https://www.youtube.com/watch?v=cZSYukWvpsE
Course Instructor	Prof. Rangan Benarjee, Department of Energy Science & Technology, IIT Bombay
Course Name	Design of Photovoltaic system
Course Link	https://www.youtube.com/watch?v=hr2sId412zU&list=PLuv3GM6-gsE2KyXoBTQ6lbrwn22Z3SiVm&index=2
Course Instructor	Prof. L. Umanand, Department of Electronic System Engineering, IISC Bangalore

Subject Code: 19EE5OE02T	Subject Name: Sensor and Instrumentation	L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVES:

The students will

1. Understand the concepts of measurement technology.
2. They learn the various sensors used to measure various physical parameters.
3. They will learn the fundamentals of signal conditioning and data acquisition.
4. Learn how to use virtual instrumentation for measurement.

SYLLABUS

Module-1 **(8 Hours)**

Sensors & Transducer: Definition, Classification & selection of sensors, Elements of a general measurement system: Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

Module-2 **(8 Hours)**

Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor

Module-3 **(8 Hours)**

Signal Conditioning Elements: Deflection bridges: design of resistive and reactive bridges,push-pull configuration for improvement of linearity and sensitivity. Amplifiers:Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting anddifferential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phasesensitive demodulators and its applications in instrumentation

Module-4 **(10 Hours)**

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs,Structures: Case, Sequence & Formula nodes, need of software based instruments for industrial automation.

Module – 5 **(4 Hours)**

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication

COURSE OUTCOMES:

After completion of the course, the student will be able to

1. Apply the use of sensors for measurement of displacement, force and pressure.
2. Employ commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level.
3. Demonstrate the use of virtual instrumentation in automation industries.
4. Identify and use data acquisition methods.
5. Comprehend intelligent instrumentation in industrial automation.

TEXT BOOKS:

1. J.P. Bentley, Principles of Measurement Systems- 3rd edition, Pearson Education, New Delhi,2007.
2. Jovitha Jerome,Virtual Instrumentation Using LabVIEW,PHI Learning Pvt. Ltd., New Delhi-1100012010

REFERENCE BOOKS:

1. Introduction to Measurement and Instrumentation- A.K. Ghosh (3/e), PHI Learning,New Delhi, 2009.
2. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010

DIGITAL LEARNING RESOURCES:

Course Name	Sensor and Transducer
Course Link	https://nptel.ac.in/courses/108/108/108108147/ https://nptel.ac.in/courses/108/105/108105064/
Course Instructor	Dr. Hardik Jeetendra Pandya, Department of Electronic Systems Engineering, IISc Bangalore Prof. Alok Barua, Department of Electrical Engineering, IIT Kharagpur.

Open Elective-1(for EE Branch Students)

Subject Code:	Subject Name:	L-T-P:	Credit:
19IT5OE01T	Java Programming	3-0-0	3

COURSE OBJECTIVE:

1. Learn the syntax, semantics and idioms of the Java programming language.
2. Gain confidence in object oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries.

SYLLABUS:

Module- 1 **(8 Hours)**

Introduction to Java and Java programming Environment. Object Oriented Programming Concepts: Encapsulation, Abstraction, Inheritance, Polymorphism.

Fundamental Programming Structure: Data Types, variable, keywords, typecasting, Arrays, Operators and their precedence.

Control Flow: Java's Control Statements (if, switch, iteration, statement, while, do-while, for, Nested loop). Concept of Objects and Classes, Using Existing Classes building your own classes, constructor overloading, static , final, this keyword.

Module - 2 **(8 Hours)**

Inheritance: Introduction, types of inheritance. Use of super keyword. Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.

Packages & Interfaces: Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Module –3 **(8 Hours)**

Exception Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.

String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string.

Module 4 **(6 Hours)**

Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

Multi Threading: Java Thread Life Cycle, Thread Priorities, Synchronization, Creating a thread, Runnable interface, Creating Multiple threads, Using isAlive () and join (), wait () & notiCS().

Module-5 **(10 Hours)**

Wrapper Classes: Wrapper classes and its methods.

Collection Framework: Introduction, interfaces, List, Set, Map etc, List interfaces and its classes.

Event Handing: Event Delegation Model, Event Classes, Event Listener Interfaces, Adapter classes.

AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame, working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.

COURSE OUTCOMES:

1. Implement and apply various Object Oriented programming concepts.
2. Applying Collection Classes and Files, Multiple Threads, & handle Exceptions indeveloping a java applications.
3. Developing a Java standalone application having front end design and back end.

TEXT BOOKS:

1. Java: One Step Ahead by Anita Seth (Author), B.L. Juneja (Author) Oxford UniversityPress.
2. Head First Java 2nd edition Kathy Sierra & Bert Bates
3. JAVA Complete Reference (9th Edition) Herbert Schildt.

REFERENCE BOOKS:

1. https://www.udemy.com/java-the-complete-java-developer-course/
2. Java Programming Masterclass for Software Developers Created by Tim Buchalka, TimBuchalka's Learn Programming Academy, Goran Lochert

DIGITAL LEARNING RESOURCES

Course Name	Foundation Engineering

Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

Subject Code: 19CS5OE01T	Subject Name: Introduction Python Programming	L-T-P: 3-0-0	Credit: 3

COURSE OBJECTIVE:

1. Identify/characterize/define a problem.
2. Design a program to solve the problem.
3. Create executable code.
4. Read most Python code and write basic unit tests.

SYLLABUS:

Module-1: **(10 Hours)**

Features and History of python, Literal constants, variables and identifiers, data types, Input operations, comments, reserve words, indentation, operators and expressions, operations on strings, other data types, conditional branching statements, loop structures, break, continue, pass, else. Functions in python.

Module-2: **(10 Hours)**

Concatenating, appending and multyplying strings, string formatting operator, built in string methods and functions, slice operation, ord() and chr(), in and not in operations, comparing strings, iterating strings, string module, match(), search() and sub(), findall() and finditer(). Data structures: sequence, lists, functional programming, tuple, sets, dictionaries,

Module-3: **(10 Hours)**

Classes and objects: class methods and self arguements, the _init_(), class variable and object variable, _del_(),public and private data members, calling a class method from another class method, builtin funcitons to set,get and delete class attributes .Inheritance, types, composition or containership, abstract classes or interfaces Operator overloading: implementing Operator overloading, reverse adding, overriding _getitem_() and _setitem_() methods, overriding the in operator, overloading the misc functions

Module-4: **(10 Hours)**

Error and exception handling: handling exceptions, multiple exception blocks, multiple exceptions in a single block, except block without exception, else clause, raising exception, instantiating exceptions, handling exceptions in invoked functions, built-in and user defined exceptions, the finally block, predefined cleanup action.

COURSE OUTCOME:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.

TEXT BOOKS

1. Python programming, Reema Thareja, Oxford publications
2. Learning python , Mark lutz, oreilly

REFERENCE BOOKS:

1. Statistics and Machine Learning in Python Release 0.1, Edouard Duchesnay, Tommy Löfstedt
2. Python data Analytics , Fabio Nelli, Apress.

DIGITAL LEARNING RESOURCES

Course Name	Programming Data Structures and Algorithm in Python
Course Link	https://nptel.ac.in/courses/106/106/106106145/
Course Instructor	Prof. Madhavan Mukund Chennai Mathematical Institute

Subject Code:	Subject Name:	L-T-P:	Credit:
19EC5OE01T	VLSI DESIGN	3-0-0	3

COURSE OBJECTIVE:

1. To understand the concept of VLSI Design Methodology, Design Flow, fabrication steps of NMOS as well as CMOS process and MOSFET the static and switching behavior of MOS Inverter.
2. To understand the design and working of combinational and sequential MOS circuits.
3. To understand the concept of semiconductor memories.
4. To understand the concept of Layout of CMOS Digital Circuits, DRC, LVS and RCX

SYLLABUS:

Module-1 **(8 Hours)**

Introduction, Historical perspective, VLSI Design methodologies, VLSI Design Flow, Design Hierarchy, Design Styles, CAD Technology .(Text Book 1 ,Chapter 1(1.1,1.4,1.5,1.6,1.8,1.11)) Fabrication of MOSFETS, Fabrication processes, NMOS Fabrication, CMOS n-well process,Layout Design rules, Stick Diagrams, Full Custom Mask Layout Design. MOS Transistor, Review of structure and operation of MOSFET (n-MOS enhancement type), CMOS, MOSFET V-I characteristics, MOSFET scaling and small geometry effects, MOSFET capacitances.

Module-2 **(10 Hours)**

MOS Inverters:

Basic NMOS inverters, characteristics, inverters with resistive load and with n-type MOSFET load, CMOS inverter and characteristics.

MOS inverters: Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasitic switching power dissipation of CMOS inverters.

Module- 3 **(8 Hours)**

Combinational MOS logic circuits:

CMOS logic circuits, state style, complex logic circuits, pass transistor logic. (Text Book 1, **Chapter 7 (7.3, 7.4, 7.5))**

Sequential logic circuit – introduction, SR latch, clocked latch & flip-flop circuits, CMOS D latch and edge triggered flip-flop**.**

Module-4 **(6 Hours)**

Semiconductor Memories:

Introduction, Read Only Memory Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits.

Module-5 **(8 Hours)**

Layout concepts and examples of CMOS Inverter, 2-Input NAND Logic Gate, 2-Input NOR Logic Gate, 2:1 Multiplexer using Transmission Gate, D-Latch using Transmission Gate, Concept of DRC, LVS and RCX.

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Analyze the characteristic of MOSFET, understand the fabrication steps, design CMOS inverters, calculate the dimension of MOSFETs for delay and inverter threshold voltage.
2. Design combinational and sequential circuits using CMOS technology and verify their functionalities.
3. Analyze the memory cells and verify its functionality
4. Analyze the layout and verification of CMOS integrated circuits.

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici and Chul Woo Kim, CMOS Digital Integrated Circuits: Analysis and Design, 4th Edition, Tata McGraw-Hill Publishing Company Limited, 2015. **(Some portions of modules 1, 2, 3, 4 and 5)**
2. Debaprasad Das, VLSI Design, 2nd Edition, Oxford University Press, 2015, New Delhi.

(Some portions of modules 1, 2, 3, 4 and 5)

REFERENCE BOOKS:

1. Neil h. e. weste, David Harris and Ayan Banerjee, CMOS VLSI design a circuits andsystems perspective, 4th Edition, Pearson Education, 2015.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits– A Design Perspective, 2nd Edition, PHI Learning, 2016, New Delhi
3. Douglas A. Pucknell and K. Eshraghian, Basic VLSI Design, 3rd Edition, PHI Learning, 2009, New Delhi

DIGITAL LEARNING RESOURCES:

Course Name	CMOS Digital VLSI Design
Course Link	https://nptel.ac.in/courses/108/107/108107129/
Course Instructor	Prof. Sudeb Dasgupta | IIT Roorkee

Course Name	Digital VLSI Design
Course Link	https://nptel.ac.in/courses/108/103/108103108/
Course Instructor	Prof. Chandan Karfa | IIT Guwahati

Subject Code:	Subject Name:	L-T-P:	Credit:
19EC5OE02T	Microprocessor And Interfacing	3-0-0	3

COURSE OBJECTIVE:

1. Understand the main components and working principle of the Intel 8086 microprocessor and its programming
2. Understand the Memory organization, interfacing and the interrupt concept of 16-bit microprocessor
3. To make the interfacing of the I/O devices using programmable interfacing devices
4. To enable the students to understand the basic components and working principle of the Intel 32-bit processor80386

SYLLABUS:

Module-1 **(10Hours)**

8086 Microprocessor:

Introduction: Overview of Microcomputer organization.

Intel 8086 Microprocessor: Introduction, 8086 Programmer's model: Register organization, Hardware Architecture: Bus interface unit (BIU), Execution unit (EU), Pipelined operation, physical address generation and Memory segmentation. 8086 Pin description: Common, Minimum and maximum mode Pin and Signals, Bus cycle and System configuration.

Module-2 **(8Hours)**

8086 Memory Interfacing and Interrupt technique: 8086 Memory Interfacing: External Memory addressing, EPROM and RAM interface with 8086. 8086 Interrupt: Interrupt Processing, sources of interrupt in 8086, Interrupt Instructions, Interrupt types, IVT, Hardware Interrupts and Interrupt priorities.

Module-3 **(8Hours)**

8086 Instruction set and programming: 8086 Addressing modes, Instruction set: data transfer, arithmetic, bit manipulation, branch and processor control, assembler directives and programming

Module-4 **(10Hours)**

Peripheral interfacing and its programming:

Introduction to basic I/O interface, I/O interfacing techniques in 8086. Interfacing devices: 8255 PPI, 8254 Timer, 8251 USART, ADC-0808/0809, and DAC-0800 interfacing using PPI.

Module-5 **(8Hours)**

32-bit Microprocessor 80386: Salient features of 80386, Architecture and Signal Description of 80386. Register Organization of 80386, Hardware Memory organization 80386 Memory management: Real mode, Segment translation, protected mode, Memory paging mechanism and Virtual 8086Mode

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Gain deep knowledge on 8086 microprocessor architecture and pin and signals and demonstrate the memory interfacing and illustrate the use ofinterrupts.
2. Identify the addressing modes and illustrate the different classification and functions of 8086 microprocessor instructions and apply the knowledge in assembly language programming.
3. Illustrate the design aspect of I/O interface and Design and development of interfacing various I/O devices using programmable peripheral devices with the 8086 microprocessor.
4. Study and understand the architecture and memory management system of 80386 advanced microprocessors.

TEXT BOOKS:

1. A. K. Ray and K. M. Bhurchandi, “Advanced Microprocessors and Peripherals”, 3rd Edition, Tata McGraw Hill Education,2000, New Delhi.
2. Walter A Triebel and Avtar Singh, “The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications”, 4th edition, Pearson Education, 2014, Noida

REFERENCE BOOKS:

1. Barry B. Brey, The Intel Microprocessors, Architecture, Programming and Interfacing, 8th Edition, Pearson Education, 2009,Noida

2. Doughlas.V.Hall, Microprocessor and Interfacing : Programming and Hardware, 2nd Edition, McGraw Hill, 1992,Noida
3. Yu-chengliu and Glenn a. Gibson, Microcomputer Systems: The 8086/8088 Family Architecture, Programming & Design-, 2ndEdition, Prentice Hall of India, 2007, New Delhi

DIGITAL LEARNING RESOURCES:

Course Name	Microprocessors and interfacing
Course Link	https://nptel.ac.in/courses/108/103/108103157/
Course Instructor	Prof. Shaik Rafi Ahmed, Department of Electronics and Electrical Engineering, IIT Guwahati

Course Code:	Course Name:	L-T-P:	Credit:
19ME5OE03T	Micro Electro-Mechanical Systems[MEMS]	3- 0- 0	3

COURSE OBJECTIVES:

1. Learning fundamental concepts for design of micro-electromechanical devices (MEMS), including mechanical and thermal behavior of materials and structures, transduction principles, transducer design, and modeling.
2. Learn about the current and future trends of MEMS in the industry. Types of MEMS devices, their application areas.
3. Acquire comprehensive knowledge of microfluidic devices.
4. Learn different techniques for fabrication of MEMS devices, materials used and their properties.
5. Learn analytical/mathematical modeling of a MEMS device. Gain knowledge on capabilities of different tools used in the industry.

SYLLABUS:

Module-1 **(7 hours)**

Introduction to MEMS

History of micro system technology, overview of commercial MEMS products, future trends, Case study, Micro-fabrication basics and materials used. Miniaturization : Moore's law, Effects of scaling: on mechanical strength, heat transfer, vibrational and magnetic characteristics. Benefits and limitations of the materials and miniaturization.

Module-2 **(8 hours)**

MEMS types, application areas

Mechanical Transducer: Inertial Sensors (Accelerometer, Gyroscope), Pressure Sensors, Flow Sensors, Force Sensors (SPM), Magnetic Transducers: Magnetic Field Sensors, Magnetic Actuators, Proximity sensor; Chemical/Biological Transducers: Gas sensor, Thermal Transducers: Thermometers, IR Sensors; Applications of MEMS: smart homes, electrical systems, material transport, condition monitoring, biomedical prosthesis. Packaging of MEMS devices : Standard Packages, Packaging Concepts, Packaging Examples

Module-3 **(7 hours)**

Micro fluidics:

Fundamentals of fluid mechanics, Basic components of a micro-fluidic system, Micro flows, Micro pumps, Capillarity and Surface Tension, Micro pumping methods, Micro dispensers, Micro nozzles

Module-4 **(7 hours)**

Materials and Fabrication techniques of MEMS

Properties of materials used in MEMS fabrication : silicon, polymers, metals, ceramics. Their structure and properties. Structure of silicon and other materials (polymers), Silicon wafer processing, Bulk micro machining and Surface micro machining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.

Module-5 **(9 hours)**

Modeling of MEMS structures

System modeling of MEMS : Analytical vs Numerical Modeling, Lumped Element modeling, Finite element modeling; MEMS simulation packages : MEMS pro, MEMS+, SUGAR, Coventor, Soft MEMS, COMSOL etc. Demonstration of MEMS pro-Ansys integration

COURSE OUTCOMES:

1. Understand the operation of micro devices, micro systems and their applications.
2. Select whether the particular situation requires the use of a MEMS device. If required, select an appropriate device.
3. Analyze a chemical/biological system to select the right microfluidic device.
4. Apply knowledge of physical, chemical and biological principles to engineer MEMS devices using different materials and techniques. Select appropriate MEMS fabrication techniques for a particular design and application.
5. Apply knowledge of MEMS analysis to evaluate suitability of MEMS designs for particular applications. Select a suitable tool for a

TEXT BOOKS:

1. Smart Material Systems and MEMS:Design and Development Methodologies, Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, Wiley, 2006
2. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGrawHill, New Delhi, 2002

REFERENCE BOOKS:

1. MEMS Sensors, Design and Application, Siva Yellampalli, IntechOpen, 2018
2. MEMS : Design and Fabrication, Mohamed Gad-el-Hak, CRC Press, 2005
3. Microsystem Design, Stephen D. Senturia, Springer US, 2001

Subject Code:	Subject Name:	L-T-P	Credits:
19CE5OE01T	Building Services and Maintenance	3-0-0	3

COURSE OBJECTIVE:

1. To explain the activities involved in maintenance of a building
2. To know services of the anti termite treatment and repair of pipes, sanitary works and joints.
3. To analyse the strengthening technique of foundations
4. To understand the strengthening technique of beams, column slab and masonry walls
5. To understand water supply systems in a building and its maintenance

SYLLABUS:

Module-1 **(8 hours)**

Maintenance of Building: White washing, colour washing and distempering, painting, replacement of glass panels, re-polishing of terrazzo and mosaic, replacement of decayed timber, easing of doors and windows, repairs to damaged part of the flooring.

Module-2 **(8 hours)**

Removal of stains from concrete and terrazzo floor, anti termite treatment in building, foundations, floors and wood work , repairing of plumbing, drain and sanitary works. Repair of water storage sumps and tanks

Module-3 **(8 hours)**

Special Repairs: Strengthening of foundation and foundation soils, rectification of leaking roof and concrete cover spalled roof, repairs to crack in masonry wall, repairs to leakage at window sill, special repairs to joinery work at roof level, providing D.P.C. to the exciting buildings, repairs to expansion and contraction joints, repairs to ramped floors.

Module-4 **(6 hours)**

Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall

Module-5 **(10 hours)**

Water quality, Purification and treatment- water supply systems-distribution systems in small towns – types of pipes used- laying jointing, testing-testing for water tightness plumbing system for building-

internal supply in buildings- municipal bye laws and regulations - Rain Water Harvesting - Sanitation in buildings-arrangement of sewerage systems in housing -pipe systems storm water drainage from buildings -septic and sewage treatment plant – collection, conveyance and disposal of town refuse systems.

COURSE OUTCOME:

After completion of the course the student is able to

1. analyse the activities involved in maintenance of a building
2. evaluate various anti termite treatments and repair of pipes, sanitary works and joints
3. design the strengthening technique of foundations
4. analyse the strengthening technique of beams, column slab and masonry walls
5. design water supply systems in a building and its maintenance

TEXT BOOKS:

1. V. N. Vazirani and S.P. Chandola, "*Building Construction*", Khanna Publishers, New Delhi, India.

REFERENCE BOOKS:

1. B. Chanter and P. Swallow "*Building Maintenance Management*", Second Edition, Wiley-Blackwell, 2017, New Jersey, United States.
2. General Specification for Building Maintenance Works in Residential Buildings, prepared by Building Surveying Division, HKIS

DIGITAL LEARNING RESOURCES:

Course Name	Fire Protection, Services and Maintenance Management of Building
Course Link	https://nptel.ac.in/courses/105/102/105102176/
Course Instructor	Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi

Subject Code:	Subject Name:	L-T-P	Credit:
19CE5OE02T	Green Technology	3-0-0	3

COURSE OBJECTIVE:

1. Study of global warming and its effect and also to choose the proper way for planning of future to reduce the global warming.
2. To analyze the opportunities in control of carbon emission and accumulation.
3. To gain knowledge about the various use of green technologies for energy production.
4. To understand the personal, citywide and specific applications of green technologies.
5. To know some high-tech measures for the reduction of carbon emission and recommended plan of action.

SYLLABUS:

Module-1 **(8 hours)**

Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact.

Planning for the Future to reduce global warming:- Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.

Module-2 **(8 hours)**

Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India —More Forests, Less

Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India.

Module-3 **(8 hours)**

Green Technologies for Energy Production :- Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.

Module-4 **(8 hours)**

Green Technologies for Personal and Citywide Application :- Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports.

Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC),Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbors, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects ,'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.

Module-5 **(8 hours)**

Some High-tech Measures for Reducing Carbon Emissions :- Use of Solar Power with Satellite-Based Systems ,Use of Carbon Capture and Storage (Sequestration) ,Microorganisms, A Quick SWOT Analysis.

Recommended Plan of Action :- India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, Few case studies on Projects undertaken by Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

COURSE OUTCOME:

After completion of the course the student can

1. To understand the global warming effect and the planning of future to reduce the global warming.
2. Ability to determine the control of carbon emissions and accumulation.
3. Identify the various technologies available for energy production.

4. Apply some green technologies specific application for carbon emission reduction like personal level, local authority, and citywide level.
5. Able to analyse some high-tech measures for carbon emission and recommended plan of action.

TEXT BOOKS:

1. Soli J. Arceivala "*Green Technologies*", First Edition, McGraw Hill Education (India) Private Limited, 2014, New Delhi.

REFERENCE BOOKS:

1. R. Singh and S. Kumar "*Green Technologies and Environmental Sustainability*" First Edition, Springer International Publishing, 2017.

DIGITAL LEARNING RESOURCES:

Course Name	Sustainable Materials and Green Buildings
Course Link	https://nptel.ac.in/courses/105/102/105102195/
Course Instructor	Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi

Subject Code:	Subject Name:	L-T-P	Credit:
19EE5OE03T	Smart Grids	3- 0- 0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

1. To understand the basic concepts, components and architecture of smart grid
2. To understand the various measurement technologies in smart grid
3. To educate the importance of renewable energy in smart
4. To know about battery technology and energy storage
5. To brief about role of Electric Vehicles in smart grid

SYLLABUS

Module-1 **(6 Hours)**

Introduction to Smart Grid

Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India, differences between traditional grid and smart grid.

Module-2

Concept of Microgrids **(7 Hours)**

Introduction to the concept of microgrid, the overview of the structure and architecture of microgrid with brief control, operational aspects. Recent pilot microgrid projects and their outcomes.

Module-3

Control of Smart Power Grid System **(8 Hours)**

Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid

Module-4 **(7 Hours)**

Energy Storage Systems

Batteries, Super Conducting Magnetic Energy Storage System, Pumped Hydro, Compressed Air Energy Storage, Flywheel, Ultra capacitors.

Module-5 **(8Hours)**

Phasor Measurement Units Importance of PMUs, Phasor Measurement Units and Phasor Data Concentrators Wide Area Monitoring: WAMS concept, data collection, WAMS architecture, Advanced data processing, optimal placement of PMUs.

COURSE OUTCOMES:

After completion of the course, the student will be able to

1. Understand the features of Smart Grid.
2. Understand the basic concepts of micro grid and characteristics of energy storage devices.
3. Understand the concepts of Phasor measurements in power system.
4. Analyze the power system behavior using synchronized phasor measurements.

TEXT BOOKS:

1. S. Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press, 1st Edition, 2013.
2. N. D. Hatziargyriou, “Microgrids Architecture and control”, IEEE Press Series, John Wiley & Sons Inc, 1st Edition, 2013.
3. A. R. Messina, “Wide Area Monitoring of Interconnected Power Systems”, IET publisher, 1st Edition, 2015.

REFERENCE BOOKS:

1. Arun G. Phadke, James S. Thorp, “Synchronized Phasor Measurements and Their Applications”, Springer International Publishing AG 2008, 2nd Edition, 2017.
2. Ali Keyhani, “Design of Smart power grid renewable energy systems”, Wiley IEEE,2011.
3. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRCPress, 2009.
4. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press.
5. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.

6. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving”, Artech House Publishers July 2011

DIGITAL LEARNING RESOURCES:

Course Name	Introduction to Smart Grid
Course Link	https://nptel.ac.in/courses/108/107/108107113/
Course Instructor	Prof. N P Padhy & Prof. Premalata Jena, Department of Electrical Engineering, IIT Roorkee

Subject Code:	Subject Name:	L-T-P	Credit :
19EE5OE04T	Introduction to Electrical Properties of Materials	3-0-0	3

COURSE OBJECTIVES:

1. To understand the conducting properties of metal.
2. To give knowledge about semiconductor materials.
3. To give knowledge about the insulating materials and their applications.
4. To acquire the knowledge about the dielectric materials.
5. To have knowledge about magnetic materials.
6. To have knowledge about special purpose materials.

SYLLABUS

Module-1 **(8 Hours)**

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission.

Module-2 **(6 Hours)**

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity.

Module-3 **(9 Hours)**

Dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant. Dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, Ferro-electricity, piezoelectricity.

Module-4 **(8 Hours)**

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, para-magnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance. Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density.

Module-5 **(8 Hours)**

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

COURSE OUTCOMES:

After the completion of the course, the students will be able to

1. Understand the various kinds of materials and their applications in ac and dc fields.
2. Understand the conductivity of superconductivity of materials.
3. Explain the electrical properties of different materials and metallic behavior of materials on the basis of band theory.
4. Explain the properties and applications of all kind of magnetic materials.
5. Explain the properties of electrical conducting and insulating materials.
6. Assess a variety of approaches in developing new materials with enhanced performance to replace existing materials.

TEXT BOOKS:

1. C. S. Indulkar and S. Thiruvengadam, S., "An Introduction to Electrical Engineering
2. Kenneth G. Budinski, "Engineering Materials: Prentice Hall of India, New Delhi
3. ELECTRICAL PROPERTIES OF MATERIALS, 9th Edition (L. Solymer, Donald Walsh,R. R .A. Syms)
4. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.

REFERENCE BOOKS:

1. Electrical Engineering Materials Adrianus J Dekker, Phi Learning Publishers.
2. Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by Indulkar C, S. Chand & Company Ltd-New Delhi.

DIGITAL LEARNING RESOURCES:

Course Name	Processing of Semiconducting Materials
Course Link	http://nptel.ac.in

Course Instructor	Dr. Pallab Banerji,Department of Metallurgy and Material Science,IIT Kharagpur.

Open Elective-2 (for EE Branch Students)

Subject Code:	Subject Name:	L-T-P:	Credit:
19IT5OE02T	COMPUTER NETWORKS	3-0-0	3

COURSE OBJECTIVES:

1. Understand the concepts of data communication, layered model, wireless devices in computer networks.
2. Explain the various techniques used to access a shared channel in the network and IEEE specifications for LANs.
3. List types of networking devices, backbone networks and Internet Protocol (IP) addressing.
4. Explain the responsibilities of network, transport and application layers.

SYLLABUS

Module-1 **(12 Hours)**

Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol.

Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, Digital Transmission: Digital-to-Digital conversion, Analog-to Digital conversion, Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion, Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, Datagram Network, Virtual-Circuit Network.

Module-2: **(12Hours)**

Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding. Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol

Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing).

Module-3: **(10Hours)**

IEEE 802.11 and Bluetooth. Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway. Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers.

Module-4: **(6 Hours)**

Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols.

Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Module-5: **(6 Hours)**

Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document.

COURSE OUTCOME:

1. Explain computer network reference models, networking devices and different transmission techniques.
2. Reason the need for flow and error control at the data link layer and explain the associated protocols; enumerate the shared channel access methods, associated protocols and Wired LAN standards and implementations.
3. Explain how network layer, transport layer and application layer facilitates the transfer of message from one node to another in a global network.

TEXT BOOK:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw Hill, 5th Edition(2013).

2. Computer Networks, A. S. Tannenbum, D. Wetherall, Pearson Education, 5th Edition(2014).
3. Data and Computer Communications, William Stallings, Pearson Education, 10th Edition(2018).

REFERENCE BOOK:

1. Computer Networking, A Top-Down Approach, James F. Kurose, Keith W. Ross, Pearson publication, 6th Edition(2017).
2. http://www.nptelvideos.in/2012/11/computer-networks.html, Prof. Sujoy Ghosh, IIT, Kharagpur.
3. https://nptel.ac.in/courses/106105183/, Prof. SoumyaKantiGhosh, IIT, Kharagpur.
4. https://www.classcentral.com/course/stanford-openedx-introduction-to-computer-networking-1578, Prof. Philip Levis and Professor Nick McKeown, Stanford University.

DIGITAL LEARNING RESOURCES

Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

Subject Code:	Subject Name:	L-T-P:	Credit:
19CS5OE02T	DATABASE MANAGEMENT SYSTEM	3-0-0	3

COURSE OBJECTIVE:

1. To learn data models, conceptualize and depict a database system using ER diagram
2. To understand the internal storage structures in a physical DB design
3. To know the fundamental concepts of transaction processing techniques

SYLLABUS:

Module-1: **(5 Hours)**

Introduction: Purpose of Database System: - Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes relationships,relationship types, E/R diagram notation, examples.

Module-2: **(10 Hours)**

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

Module-3: **(7 Hours)**

Database Design: Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

Module-4: **(10 Hours)**

Transaction: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Module-5: **(8 Hours)**

Implementation Techniques: Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi- level indexes, B+ trees.

COURSE OUTCOMES:

1. Ability to Install, configure, and interact with a relational database management system
2. Ability to master the basics of SQL and construct queries using SQL
3. Ability to design and develop a large database with optimal query processing

TEXT BOOK:

1. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 7thEd,Tata McGraw Hill, 2019.
2. C. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8thed,Pearson Education, 2006

REFERENCE BOOK:

1. RamezElmasriand Shamkant B. Navathe, "Fundamentals of Database Systems", 7thEdition, Pearson/Addisionwesley, 2016
2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003

DIGITAL LEARNING RESOURCES:

Course Name	Database Systems Course
Course Link	https://nptel.ac.in/courses /106/104/106104135/
Course Instructor	Dr. Arnab Bhattacharya, IIT,Kanpur

Course Name	Introduction to Database Systems
Course Link	https://nptel.ac.in/courses/106 /106/106106220/
Course Instructor	Prof. P.Sreenivasa Kumar, IIT,Madras

Subject Code:	Subject Name:	L-T-P:	Credit:
19EC5OE03T	EMBEDDED SYSTEM DESIGN	3-0-0	3

COURSE OBJECTIVES:

1. To get the knowledge of the Embedded technology and its utility to the society.
2. Understanding the architecture and programming of embedded processor (ARM or FPGA) or micro controller
3. Familiarization with the embedded computing platform design and analysis.
4. To acquire the knowledge in interfacing protocols and related Hardwires.

SYLLABUS:

Module-1: **(10 Hours)**

Introduction to Embedded Systems:

Hardware and Software Concepts: Embedded Systems, Application and characteristics of Embedded System, Overview of Processor and Hardware Units in Embedded System, Embedded Software into a system, Introduction to Embedded System Design, Introduction to Embedded System Architecture.

System-on-Chip, NoC, Embedded Hardware Modeling and Design: System-on-chip (SoC), Network-on-chip (NoC), Levels of Hardware modeling, Embedded Hardware Design and Development.

Module-2: **(8 Hours)**

8051, AVR AT mega and ARM Microcontrollers:

Microcontrollers, AVR Microcontrollers, ARM processor –based system Design

Sensors, A/D–D/A Converters, Actuators and Interfacing:

Sensors, A/D–D/A Converters, Actuators, interfacing Techniques, Network Embedded System, Internet-Enable Systems-Network Protocols, Wireless and Mobile System Protocols

Module-3: **(8 Hours)**

Real-Time Operating System (RTOS) and Real-Time task scheduling:

RTOS: concepts, types of Real time Task and their characteristics, task scheduling, Feature of RTOS, device driver, interrupts and Service mechanism

Module– 4: **(8 Hours)**

IoT System- System Architecture and Design:

IoT, Internet connectivity and IoT connectivity, Edge computing Architecture and Application, IoT communication module Protocols, Rapid prototype designing using open source Boards.

Module– 5: (8 Hours)

Embedded AI- System Architecture and Design:

Artificial Intelligence Embedded AI hardware and Software Development, Embedded AI Application

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Design an embedded system application
2. Implement the peripheral interfacing.
3. Use system design techniques to develop firmware
4. Develop embedded system solution to automation and IoT Application.

TEXT BOOKS:

1. K. V. SHIBU, Introduction to Embedded Systems, McGraw Hill Publication Company Limited, 2009, New Delhi.

REFERENCE TEXT BOOKS:

1. Raj Kamal, Title Embedded Systems, 4th Edition, McGraw Hill Publication Company Limited, 2020, New Delhi.
2. David E. Simon, Addition Wesley, An Embedded Software Primer, Wiley, 1999, New Delhi.
3. K. Short, Embedded Microprocessor Systems Design: An Introduction Using the Intel 80C188EB, Prentice Hall,1998, ISBN-10 : 0132494671,ISBN-13 :978-0132494670.

DIGITAL LEARNING RESOURCES:

Course Name	Embedded System Design
Course Link	https://nptel.ac.in/courses/106/105/106105159/
Course Instructor	Prof. AnupamBasu, Department of Computer Science and Engineering, IIT Kharagpur

Subject Code:	Subject Name:	L-T-P:	Credit:
19EC5OE04T	RADAR SYSTEM ENGINEERING	3-0-0	3

COURSE OBJECTIVE:

1. To learn the basics of the RADAR fundamentals and familiarization with various components of Transmitter and receiver.
2. To understand the concept of radar signal and its processing techniques under ambiguity conditions.
3. To learn about different types of RADARs and their operational principles.
4. To understand basic detection theory and tracking principles of a Radar systems.

SYLLABUS:

Module-1 **(10Hours)**

Introduction to Radar:

Basic radar, maximum unambiguous range, building blocks of radar, simple form of radar equation, Block diagram of Radar transmitter, Radar frequencies, Applications to radar and related Problems.

Radar Equation : Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment). Related Problems.

Module-2 **(8Hours)**

CW and Frequency Modulated Radar:

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non- zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar.

FM-CW Radar:

Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

Module-3 **(10 Hours)**

MTI and Pulse Doppler Radar:

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar.

Module-4 **(8 Hours)**

Tracking Radar:

Tracking with Radar- Types of Tracking Radar Systems, Monopulse Tracking- Amplitude Comparison Monopulse (one-and two-coordinates), Phase Comparison Monopulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers.

Module-5 **(6 Hours)**

Radar Receiver:

Block Diagram of Radar Receiver & Radar Displays- A-scope and PPI.

Modern Radars:

Height Finding Radars, Synthetic Aperture Radar, Air borne Radar, Secondary surveillance Radar

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Demonstrate the understanding of radar fundamentals and various factors affecting the detection process.
2. Differentiate between various types of radar based on their working principles and field of application.
3. Familiarize with different displays and their applications on real time basis.
4. Analyze radar signals and various building blocks affecting it and also the detection process by applying different target centric tracking principles.

TEXT BOOK:

1. Merrill I.Skolnik, Introduction to Radar Systems, Third Edition, Tata McGraw-Hill, 2001, New Delhi.

REFERENCE BOOKS:

1. Byron Edde, Radar Principles, Technology, Applications, First Edition, Pearson Education, 2007, New Delhi.
2. Nathanson, Radar Design Principles, Second Edition, Mc-Graw Hill, 1991, NewYork.
3. Peyton Z. Peebles, Radar Principles, First Edition, Wiley, 1998, NewYork.
4. Mark A. Richards, James A. Scheer, William A. Holm. Yesdee, Principles of Modern Radar: Basic Principles, First Edition, Scitech Publishing, 2013, Raleigh, North California

DIGITAL LEARNING RESOURCES:

Course Name	Radar System Engineering
Course Link	https://nptel.ac.in/courses/108/105/108105154/
Course Instructor	Prof. AmitabhaBattacharya, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur

Subject Code:	Subject Name:	L-T-P	Credit:
19CE5OE03T	GEO-ENVIRONMENTAL ENGINEERING	3-0-0	3

COURSE OBJECTIVE:

1. To know the sub-surface contamination, geo- synthetics types and its application.
2. To gain comprehensive knowledge solid and hazardous waste management.
3. To provide knowledge on contaminant transport.
4. To understand about the remediation techniques.
5. To know the basic concept of Land fill design.

SYLLABUS:

Module-1: **(8 Hours)**

Introduction: Scope, importance, waste generation, subsurface contamination, Geo-synthetics: Types, manufacturing functions, applications and economics.

Module-2: **(8 Hours)**

Solid and Hazardous Waste Management: Classification of waste, Characterization solid wastes, Environmental Concerns with waste, waste management strategies.

Module-3: **(8 Hours)**

Contaminant Transport: Transport process, Mass-transfer process, Bioremediation, Peyote mediation.

Module-4: **(8 Hours)**

Remediation Techniques: Objectives of site remediation, various active and passive methods, Soil washing, Emerging Remediation Technologies.

Module-5: **(8 Hours)**

Landfills: Types of landfills, Site Selection, Waste Containment Liners, Leachate collection system, Cover system, Gas collection system

COURSE OUTCOME:

After completion of the course the student can

1. Understand surface contamination, geo-synthetic types and its function.

2. Analyze the classification of waste and waste management strategies.
3. Identify contaminant transport mechanisms in soils.
4. Understand the principles of soil treatment techniques
5. Get idea about different landfill concepts.

TEXT BOOKS:

1. K. R. Reddy and H D Sharma, “Geo-environmental Engineering: Site Remediation, waste containment, and emerging waste management technologies”, John Willey , New Jersey,USA
2. R N. Yong, “Geo Environmental Engineering: Contaminated Ground: Fate of Pollutions and Remediation”., Thomson Telford , London,UK

REFERENCE BOOKS:

1. L N Reddy and H.I.Inyang, “Geo-environmental Engineering: Principles and Applications”, Marcel Dek , New York,USA
2. R. W. Sarsby, “Environmental Geo-technics”, Thomson Telford , London,UK

DIGITAL LEARNING RESOURCES

Course Name	Geo-Environmental Engineering
Course Link	https://nptel.ac.in/courses/105/102/105102160/
Course Instructor	Prof. Manoj Datta, Department of Civil Engineering, IIT Delhi

Subject Code: 19CE5OE04T	Subject Name: Fluid Mechanics	L3-T0-P0	Credit: 3

COURSE OBJECTIVE:

1. Analyse fluid and its usage in flow measurement, hydraulic Machines, etc.
2. Compute pressure through manometer and design and develop marine systems with the usage of hydrostatic forces and buoyancy.
3. Differentiate velocity, acceleration, rotation and deformation etc. of fluid particles
4. Establish Euler's theorem and deduce Bernoulli's equation for a ideal fluid and real fluids
5. Examine and evaluate energy losses in fluid transmission trough pipes
6. Do the performance analysis of different turbines
7. Do the performance analysis of different types of pumps

SYLLABUS:

Module-1: **(8 Hours)**

Introduction: Scope of fluid mechanics and its development as a science Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer. Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

Module-2: **(8 Hours)**

Fluid kinematics: Introduction, description of fluid flow, classification of fluid flow. Reynold's number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity, Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net

Module-3: **(8 Hours)**

Fluid dynamics : Introduction, Introduction to N-S equation, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orifice meter, pitot tube. Flow in pipes and ducts: Loss due to friction, Minor energy losses in pipes Hydraulic Gradient Line (HGL), Total Energy Line (TEL), Power transmission in the fluid flow in pipes, fluid flow in pipes in series and parallel. Flow through nozzles.

Module-4: **(6 Hours)**

Hydraulic turbines: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in pelton wheel, efficiency and performance curves. Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation.

Module-5: **(8 Hours)**

Centrifugal Pump: constructional features, vane shape, velocity triangles, Efficiencies, Multi stage centrifugal pumps, Pump Characteristic, NPSH and Cavitation. Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram.

COURSE OUTCOME:

1. After completion of the course the student can
2. Apply conservation laws to fluid flow problems in engineering applications.
3. Design experimental procedure for physical model studies.
4. Design the working proportions of hydraulic machines.
5. Compute drag and lift coefficients using the theory of boundary layer flows.
6. Analyze and design free surface and pipe flows
7. Formulate and solve one dimensional compressible fluid flow problems

TEXT BOOKS:

1. Y. A Cengel and J. M. Simbala "*Fluid Mechanics*", McGraw-Hill Higher Education, New York, United States.

2. C. S. P Ojha, P.N. Chandramouli, and R. Berndtsson "Fluid Mechanics and Machinery", First Edition, Oxford University Press. 2010, Oxford, United Kingdom.

REFERENCE BOOKS:

1. S.K. Som and G. Biswas "Introduction to Fluid Mechanics and Fluid Machines", Third Edition, - Hill Higher Education, 2017, New York, United States

DIGITAL LEARNING RESOURCES

Course Name	Fluid Mechanics
Course Link	https://nptel.ac.in/courses/105/103/105103192/
Course Instructor	Dr. Subhashisa Dutta , Department of Civil Engineering, IIT Guwahati

Course Name	Principle of Hydraulic Machines and System Design
Course Link	https://nptel.ac.in/courses/112/103/112103249/
Course Instructor	Prof. Pranab K. Mondal, Department of Civil Engineering, IIT Guwahati

Subject Code: 19EE5PC01L	Subject Name: Power Electronics Lab	L-T-P 0- 0- 1	Credit 1

COURSE OBJECTIVES:

1. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
2. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
3. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.

COURSE OUTCOMES:

At the end of the course, a student will be able to:

1. Identify relevant information to supplement to the Power Electronics course.
2. Set up testing strategies and select proper instruments to evaluate performance characteristics of power devices and power electronics circuits and analyze their operation under different loading conditions.
3. Practice different types of wiring and devices connections keeping in mind technical, economical, safety issues.

SYLLABUS

1. Study of the V-I characteristics of SCR and measurement of its latching and holding current.
2. Study of the V-I characteristics of TRIAC.
3. Study of the cosine controlled triggering circuit.
4. Study of the single phase half wave controlled rectifier and semi converter circuit with R and R-L Load.
5. Study of single phase full wave controlled rectifier circuits (Mid point and Bridge type) with R and R-L Load.
6. Study of three phase full wave controlled rectifier circuits (Full and Semi converter) with R and R-L Load.
7. Study of the single phase PWM voltage source inverter.
8. Study the performance of three phase VSI with PWM control.

9. Study of single phase ac voltage controller with R and R-L load.
10. Study of the forward converter and flyback converter.

Subject Code: 19EE5PC02L	Subject Name: Control Systems Engineering Lab	L-T-P 0- 0- 3	Credit: 1

COURSE OBJECTIVES:

1. The students should able to learn time response analysis of a system and determine the time domain specifications.
2. The students able to understand the concept of PID controller in servomotor, temperature control system, etc.
3. The students able to understand compensators and its effect on stability of the given system
4. The students able to determine the time response, stability analysis using MATLAB

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Determine the time domain specifications of the given system
2. Understand the importance of PID controllers in position control system, temperature control system etc.
3. Design the Lead, Lag compensator for the given system.
4. Design MATLAB programming for the time response and stability analysis of the given system.

SYLLABUS

Select any 4 experiments from Control, 2 experiments form instrumentation and 2 from MATLAB from the list of 12 experiments

Control:

1. Study of a dc motor driven position control system
2. Study of speed torque characteristics of two phase ac servomotor and determination of its transfer function
3. Obtain the frequency response of a lag and lead compensator
4. To design, implement and tune P, PI and PID controllers for second order systems
5. To determine the transfer function of a system using transfer function analyzer.
6. To study use of Synchros pairs as error detector system.
7. To study and validate the controllers for a temperature control system

8. To study and implement a PID controller for a DC servo system.

Instrumentation:

1. To plot the displacement-voltage characteristics of the given LVDT
2. Measurement of temperature-voltage characteristics of J-type thermocouple
3. Use a strain gauge to plot the curve between strain applied to a beam and the output voltage
4. Study of resistance-voltage characteristics of Thermistors

MATLAB/Simulink: Using Control System Tool Box

1. Determine the time response of given system.
2. Determine the stability of a 2^{nd}order system by Routh Hurwitz Criterion.
3. Determine the stability of a given system by Bode-plot.
4. Determine the stability of a given system by Nyquist-plot.

Subject Code:	Subject Name:	L-T-P:	Credit: 1
19EE5PC03L	Digital Signal Processing Laboratory	0-0-2	

COURSE OBJECTIVES:

The object of this course is to introduce students to

1. Learn the software simulation tool like MATLAB for digital signal processing.
2. Familiarize about the architecture of DSP Processor (TMS 320C6748) and its applications.
3. Implementation of FIR and IIR filters using both hardware and software.
4. Practical Implementation of various signal processing applications using Multi-rate Signal Processing and Adaptive filter theory.

LIST OF EXPERIMENTS
(AT LEAST 10 EXPERIMENTS SHOULD BE DONE)

1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. To find DFT / IDFT of given DT signal using MATLAB and DSK 6748 KIT.
3. Program to obtain Linear Convolution of Long duration sequences using Overlap Add and Overlap Save using MATLAB.
4. Implementation of FFT of given sequence using MATLAB.
5. Generation of Real time SIN, COS AND RAMP signals using DSK 6748 KIT.
6. Implementation of Low Pass FIR filters using different window for a given sequence using MATLAB and DSK 6748 KIT.
7. Implementation of High Pass FIR filters using different window for a given sequence using MATLAB and DSK 6748 KIT.
8. Implementation of Low Pass IIR filters for a given sequence using MATLAB and DSK 6748 KIT.
9. Implementation of High Pass IIR filters for a given sequence using MATLAB and DSK 6748 KIT.
10. Implementation of Decimation Process using MATLAB and DSK 6748 KIT.

11. Implementation of Interpolation Process using MATLAB and DSK 6748 KIT.
12. To Implement and analyze the sampling and reconstruction principle and the effect of sampling on the frequency-domain using MATLAB.
13. Implementation of LMS algorithm using MATLAB.
14. Design and implementation of Adaptive noise cancellation.
15. Design and implementation of adaptive channel equalization.

COURSE OUTCOMES:

On Completion of this Subject/ Course the students should be able to:

1. Implements various signal processing applications using MATLAB (Signal Processing tool box).
2. Apply discrete-time transform techniques to analyze the discrete time signals and systems.
3. Design and analyze digital filters for processing of discrete time signals.
4. Employ digital signal processing techniques for multidisciplinary applications (such as System Identification, Adaptive Channel Equalization, Adaptive Line Enhancer, and Adaptive Noise Cancelation).